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view of the quality of the papers read and the number and broadly representative character of the members who took part in it.

The sessions closed with a dinner at the Bellevue-Stratford, on Saturday evening, April 24, at which about one hundred members were present and at which the speakers were: President Patton, of Princeton; the British Ambassador, Mr. Bryce; President Pritchett, of the Carnegie Foundation; President-elect Lowell, of Harvard, and President Keen, of the American Philosophical Society.

The annual election of members held at the executive session on Saturday, April 24, resulted in the election of the following candidates:

Residents of the United States.—Louis A. Bauer, Ph.D. (Berlin), Washington, D. C.; Marston Taylor Bogert, New York; Hermon Carey Bumpus, Ph.D., New York City; Alexis Carrel, M.D., New York City; Edwin Brant Frost, Williams Bay, Wis.; Robert Almer Harper, Ph.D., Madison, Wis.; William Herbert Hobbs, Ph.D., Ann Arbor, Mich.; A. V. Williams Jackson, Ph.D., LL.D., Yonkers, N. Y.; John Frederick Lewis, Philadelphia; Abbott Lawrence Lowell, Boston, Mass.; William Romaine Newbold, Ph.D., Philadelphia; Charles Bingham Penrose, M.D., Ph.D., Philadelphia; William Howard Taft, Washington; Charles Richard Van Hise, M.S., LL.D., Madison, Wis.; Victor Clarence Vaughan, M.D., Sc.D., LL.D., Ann Arbor, Mich.

Foreign Residents.—Francis Darwin, M.A., F.R.S., Cambridge, Eng.; Hermann Diels, Ph.D., Berlin; Emil Fischer, Ph.D., M.D., Berlin; Friedrich Kohlrausch, Ph.D., Marburg; Wilhelm F. Pfeffer, Ph.D., Leipzig.

SOCIETIES AND ACADEMIES

THE ACADEMY OF SCIENCE OF ST. LOUIS

On the evening of Monday, March 1, the regular meeting of the Academy of Science of St. Louis was held at the Academy Building, the feature of the program being a paper, read by Mr. Julius Hurter. The subject of the discourse, which had been compiled by Mr. Hurter and Mr. John K. Strecker, Jr., was "The Amphibians and Reptiles of Arkansas."

After stating that up to the present time definite records are obtainable from only 15 of the 75 counties of Arkansas, Mr. Hurter recorded the facts that 100 species of reptiles and amphibians have been reported from Arkansas, and 90 from Missouri. Thirteen of the Arkansas species are not known to occur in Missouri, and nineteen are not found in eastern Texas. Most of the species

are eastern and southeastern forms which find their western limit in Arkansas and the eastern half of Louisiana. Another interesting fact brought out was this—that of the 71 species occurring in both Arkansas and the eastern half of Texas, 63 are also found in the state of Missouri. Mr. Hurter showed numerous specimens in illustration of his paper, and also the blind salamanders of the world: *Proteus anguinus* (European blind salamander), *Typhlotriton spelæus* (Missouri) and *Typhlomolge rathbuni* (Texas).

At this meeting, on proper motion, duly seconded and unanimously carried, the following memorial was adopted as expressing the views of the academy; and copies were ordered sent to the speaker of the house of representatives, the president of the senate, and the gentlemen who represent Missouri in both branches of the present Congress:

"The Academy of Science of Saint Louis, an organization equally interested in the preservation and the proper and consistent utilization of the gifts of nature, respectfully urges on the Congress of the United States the desirability of promptly passing the House Joint Resolution now under consideration as a means of continuing the provisions of the Burton Bill, limiting the diversion of water from Niagara Falls, until equally effective but more permanent protection of the Falls shall be secured by adequate legislative or executive action."

The program of the meeting of the Academy of Science of St. Louis which occurred on March 15 was a paper by Mr. Otto Widmann on "The Birds of the Missouri Botanical Garden." In twenty visits to the garden during the summer of 1908, Mr. Widmann noted forty species of birds breeding there, and six species which were more or less regular visitors from near-by breeding grounds. And, besides these, there were scores of transient visitants during the migratory seasons. The breeders are the bob-white, mourning-dove, screech owl, yellow-billed cuckoo, black-billed cuckoo, red-headed woodpecker, northern flicker, chimney swift, kingbird, great crested flycatcher, wood pewee, Traill's flycatcher, blue jay, crow, cowbird, red-winged blackbird, meadow lark, orchard oriole, Baltimore oriole, bronzed grackle, goldfinch, English sparrow, English tree sparrow, chipping sparrow, song sparrow, towhee, cardinal, rose-breasted grosbeak, indigo bunting, warbling vireo, Bell's vireo, yellow warbler, yellow-throat, yellow-breasted chat, mockingbird, catbird, brown thrasher, house wren, wood thrush and robin.

Of the whole bird population of the garden, only four species are permanent residents. And these are the bob-white, flicker, mockingbird and red-bird. The regular visitors are the sparrow-hawk, king-fisher, night-hawk, humming-bird, purple-martin and cedar waxwing. The numerous hedges of dense shrubbery harbor Bell's vireo, yellow warbler, Maryland yellow-throat, chat, Traill's flycatcher and the indigo bunting. In the arboretum are found the crested flycatcher, wood pewee, wood thrush, cuckoos and the gentle mourning doves. The meadow has attracted quails and meadow-larks. The ripening mulberries are an attraction for flocks of cedar birds in early June, and the many beautiful flowers charm numberless hummingbirds later in the summer.

Thirty or more species of birds were on exhibition to illustrate Mr. Widmann's paper.

At this meeting the following resolution was adopted: "On the recommendation of its entomological section, and with approval of its council, the Academy of Science of St. Louis, on duly seconded and passed motion at its regular meeting of the fifteenth of March, 1909, respectfully urges on the members of the General Assembly of the State of Missouri, the importance of passing House Bill No. 575, and Senate Bill No. 197, providing the adequate inspection of nursery stock. At the present moment the entire orchard and nursery industry of the state is imperiled by a threatened introduction of the dreaded brown-tail moth, in the bare restriction of which New England has for years waged a costly warfare. Nothing but adequately planned and efficiently administered state inspection can protect this important industry of Missouri in the present or in future crises."

ON April 5, the Academy of Science of St. Louis met to hear a paper presented by Prof. Whinthrop Holt Chenery, of Washington University, on "The Relation of the Physiography of the Iberian Peninsula to the Development of the Spanish and Portuguese Peoples." Mr. Chenery considered the distinguishing features of the peninsula—topographic, geological and climatic—and their significance as determining factors in the historical evolution of the peoples. In particular he showed that the chief occupations of the inhabitants, ever since prehistoric times, have been determined by the physical character of the country; and that the long-continued prevalence of these occupations has produced widely divergent types of people.

The lecture was fully illustrated, and insistence was laid upon the importance of the study of

physical environment to the understanding of the Spanish-Portuguese history.

W. E. McCourt,
Recording Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 664th meeting was held April 10, 1909, Vice-President Wead in the chair. Two papers were read.

An Approximate Method of Analysis of E.M.F. Waves: P. C. AGNEW.

A knowledge of the impurities present in the E.M.F. wave given by a generator is required in many engineering and physical problems. While a large number of methods have been devised for the analysis of such E.M.F. waves, those methods which give quantitative results require highly specialized and expensive apparatus. The experiments described were undertaken to determine if it is possible to obtain reliable results by the use of condensers and portable indicating instruments only.

For the same effective voltage, a distorted wave will pass more current into a condenser than will a pure sine wave. We ought, then, to be able to use this fact to determine the amount of impurities present in a given wave. Obviously a greater accuracy can be attained if we make the analysis depend on bridge values of resistance, inductance and capacity, and so make it independent of the absolute calibrations of the voltmeter and ammeter used. This may be accomplished by replacing the condenser by a resistance and adjusting to give the same readings of ammeter and voltmeter. We may consider that each component of voltage, e_n , causes the corresponding component of current, i_n , to flow. The square of the effective value of current indicated by the ammeter is equal to the sum of the squares of the components. If in the case of the presence of the n th harmonic only, C represents the capacity, L the inductance, r the resistance, and if p is 2π times the frequency,

$$I^2 = \frac{e_1^2}{r^2 + (pL - 1/pC)^2} + \frac{e_n^2}{r^2 + (npL - 1/npC)^2}.$$

Now on removing the condenser and increasing the resistance to R , we have, for the same readings of voltmeter and ammeter,

$$I^2 = \frac{e_1^2}{R^2 + p^2L^2} + \frac{e_n^2}{R^2 + n^2p^2L^2}.$$

From these relations we get the ratio of the harmonic to the fundamental E.M.F.,

$$\frac{e_n}{e_1} = \frac{\sqrt{1/a_3 - 1/a_1}}{\sqrt{1/a_2 - 1/a_4}}.$$

where a_1, a_2, a_3, a_4 have been written for the four impedances in the denominators above.

While theoretically the method may be extended to any number of harmonics, it is practically limited to two by the accuracy of readings and by the labor of computation. Experiments in the analysis of waves built up by combining the E.M.F.'s of different machines, and also by the analysis of E.M.F. waves of single generators, show that the method is capable of an accuracy of two or three per cent. of the fundamental.

The method has the disadvantages of giving no information of the phase relations, and of not readily lending itself to the analysis of current waves. The advantages are that it requires no special apparatus; direct access to the generator, or the use of synchronous motor, is not necessary; and the accuracy is better than that of an oscillograph, though not equal to that of a curve tracer.

The Accurate Analysis of Alternating Current Waves: F. W. GROVER.

With the rapid development, in recent years, of methods and apparatus for the tracing of alternating current waves, the question of the convenient analysis of the curves obtained has become increasingly important. Although the well-known method of Fourier is the most direct and accurate, its employment seems to be quite generally regarded as too laborious for general use. This is evidenced by the appearance of a number of graphical and planimetric methods, among which may be mentioned those of Clifford, Fischer-Hinnen, and Houston and Kennelly. All these modes of procedure, however, labor under the disadvantage, inherent in all graphical methods, of inaccuracy where small quantities are involved, without any saving of time over that required to derive the values of an equal number of harmonics by the Fournier analysis if the calculation be suitably arranged.

In 1897 Rosa simplified the calculation by the use of a table from which the required products of the ordinates by the sines of the angles could be taken directly from a table. Using this, all the odd harmonics up to and including the 15th can be obtained in a little over an hour.

S. P. Thompson¹ showed that the work could be still further shortened, (1) by grouping together those ordinates which are to be multiplied by the sines of the same angle, and (2) by dividing the

¹ *Electrician*, May 5, 1905.

half wave into an even number n of equal parts, when the products divide themselves into complementary groups, so that the k th and $(n - k)$ th harmonics are found, respectively, by adding and subtracting the sums of two groups of products. He gave the complete scheme of calculation for the two cases, $n = 6$ and $n = 12$. The whole analysis in the former case may be carried through in ten minutes or even less.

The electromotive force waves of alternators with slotted armatures, however, often contain the higher harmonics to an appreciable extent, and these may greatly distort the form of the current wave in circuits containing capacity. The speaker has therefore developed the scheme of calculation for the case of 18 ordinates and has prepared a table to facilitate the multiplications. Such a table need include the ordinates up to 100 only, the fractional parts being found from the same table by shifting the decimal point. Using this method the amplitudes of all the harmonics up to and including the 17th may be determined in about half an hour with an accuracy and ease not attainable by any graphical method.

R. L. FARIS,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 458th meeting was held April 3, 1909, with President Palmer in the chair. Lantern slides made by a novel application of well-known methods were shown upon the screen by Mr. A. A. Doolittle. The silver is thoroughly removed from plates, leaving only the gelatin film; from old, unused or undeveloped plates by the usual hypo bath, and from poor or waste negatives by the reducing process with ferri-cyanide. On immersing the thoroughly washed plate in blue print solution for five minutes and subsequent drying in the dark, they may be printed upon by contact with negatives in the usual manner. They give clear high lights and contrasting effects, desirable qualities in lantern slides or transparencies. The color is a pleasing semi-translucent blue. The method is simple and can be used by the inexperienced. Beautiful window transparencies are similarly made.

The following communications were presented: *Classification of the True Fishes:* THEODORE GILL.

The speaker restricted the class Pisces to the true fishes or Teleostomes, as he had done since 1873. Two of the best zoologists of Europe (Hubrecht, of Holland, and Regan, of the British Museum) have recently come to the same con-

clusion. Regan has also recently (January, 1909) published on "The Classification of Teleostean Fishes" and admitted four subclasses of Teleostomes and 31 orders of Teleosts. The four subclasses are the same as four of those recognized by the speaker in 1896; a fifth then admitted in deference to the general sentiment at that time (Hyoganoidea) may now be suppressed. Remarks were made on the contrast between the orders recognized till past the middle of the last century and those now admitted by Mr. Regan and the speaker. Praise was accorded to Regan for his work, but the speaker was disposed to dissent from him as to certain groups and presented the following list of orders. Those named without synonyms are the same as Mr. Regan's; the synonyms added after many are the names given by Regan. It was especially insisted upon that the list was only provisional and tentative and that no significance need be attached to the exact position or sequence of some of the orders. The author is now employed in further studies of the osteology.

Our knowledge of the extinct types is in such an unsatisfactory condition that the present list is restricted to the living forms.

Class Pisces

- Subclass Dipnoi or Dipneusti.
 - Order Sirenoidei.
- Subclass Crossopterygii.
 - Order Semæopteri or Cladistia.
- Subclass Chondroganoidei.
 - Order Chondrostei.
 - Order Selachostomi.
- Subclass Teleostei.
 - Order Rhomboganoidei or Ginglymodi.
 - Order Cycloganoidei or Protospondyli.
 - Order Malacopterygii or Isospondyli.
 - Order Iniomi.
 - Order Scyphophori (S. O. Mormyroidei).
 - Order Plectospondyli (S. O. Cyprinoidei).
 - Order Nematognathi (S. O. Siluroidei).
 - Order Symbranchii.
 - Order Carencheli.
 - Order Apodes.
 - Order Lyomeri.
 - Order Opisthomi.
 - Order Heteromi.
 - Order Lyopomi (Heteromi pt.).
 - Order Xenomi (S. O. Dallioidei).
 - Order Haplomi (Microcyprini).
 - Order Symentognathi.
 - Order Salmoperæ.
 - Order Percesoces.
 - Order Rhegnopteri (S. O. Polynemoidei).
 - Order Acanthopterygii (Labyrinthici + Malacichthyes + Anacanthini + Allostriognathi pt. + Berycomorphi + Heterosomata + Percomorphi + Batrachoidei).

Order Hemibranchii (Thoracostei + Solenichthyes pt.).

Order Hypostomides.

Order Lophobranchii (Solenichthyes Solenostomoidei and Syngnathoidei).

Order Discocephali.

Order Chondrobranchii.

Order Taniosomi (S. O. Trachypteroidei).

Order Atelaxia (S. O. Stylophoroidei).

Order Xenopterygii or Xenopteri.

Order Plectognathi.

Order Pediculati.

The Guano-birds of Peru: ROBERT E. COKER.
(Illustrated with lantern slides.)

The chief guano-producing birds in order of importance are—a cormorant (*Phalacrocorax bougainvillei* Less.), the pelican (*Pelecanus molinae* (Molina) Gr.) and a gannet (*Sula variegata* Tsch.). A small petrel (*Halodroma garnoti* Less.) has some significance, and, if earlier accounts are accepted, it was formerly much more abundant and important. The penguin (*Spheniscus humboldti* Meyen) was reputed to be commercially important a few decades ago. Other interesting birds were observed on and near the islands.

The pelican has suffered most from the disturbance incident to the extraction of guano from the rookeries. The bird has been practically eliminated from the small islands of the southern region, but still breeds in great numbers on the larger islands of the north. A colony of pelicans, between twenty and forty thousand in number, was observed on the Lobos de Afuera Islands. Since 1906 the Peruvian government has enforced a "closed" season of five months annually, but it is expected that a more adequate plan of rotation will be adopted, so that the birds on certain islands may be undisturbed for periods of years. In partial adoption of this plan, the South Island of the Chincha group has been kept "closed" for nearly three years. It is estimated that, by the expiration of the three years, a deposit of twenty thousand tons will have accumulated upon this island.

THE 459th meeting was held April 17, 1909, in Hubbard Memorial Hall, with President Palmer in the chair. The evening was devoted to a lecture by Mr. Charles Sheldon, of New York, on "Experiences with Big Game in the Mt. McKinley Region, Alaska," illustrated by a large number of stereopticon views of the country and of mountain sheep, caribou, moose, lynx, bear and ptarmigan.

M. C. MARSH,
Recording Secretary